Exhibit A
SCOPE OF WORK

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2	N/A	Integrate Theory and Evaluate Data
3	N/A	Assess Conventional Models
4	X	Data Collection, Advanced Analysis Planning
5	X	Advanced Modeling
6	N/A	Specific In-depth Analyses

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	L. Lutzenhiser		
2	L. Lutzenhiser M. Moezzi		
3	L. Lutzenhiser M. Moezzi J. Woods		
4	L. Lutzenhiser M. Moezzi		
5	L. Lutzenhiser M. Moezzi J. Woods D. Sailor		
6	L. Lutzenhiser M. Moezzi J. Woods D. Sailor		

GLOSSARY

Specific terms and acronyms used throughout this work statement are defined as follows:

Acronym	Definition
BECC	Behavior, Energy and Climate Change
CPR	Critical Project Review
DR	Demand Response

Acronym	Definition
HVAC	Heating, Ventilation and Air Conditioning
PAC	Project Advisory Committee
PSU	Portland State University
UCC.1	Uniform Commercial Code (Financing Statement)

Problem Statement

The State of California and neighboring states and provinces have made ambitious commitments to reduce emissions of carbon dioxide and other greenhouse gases. A significant portion of those emissions result from energy use in buildings, and a significant portion of those are from direct combustion of fuels in residences as well as from the residential use of electricity generated by fossil fuels. Changes in residential sector emissions will require significant changes in consumers' energy use technologies and practices. Policies to promote adoption of high-efficiency and renewable energy technologies, as well as to encourage energy conserving behavior in the home, will require a much better knowledge of consumer behavior than has been needed in the past.

The limits to conventional understandings of consumer behavior and choice, and the problems that this poses for effective policies and programs (whether these are focused on energy efficiency, demand response or distributed generation), are widely recognized. They have been the focus of a good deal of research and critical evaluation in the past. Much of this work has been summarized in review articles and research reports. Recent interest in consumer behavior as an important element in energy policy and programs is evidenced in the national Behavior, Energy and Climate Change (BECC) conferences in Sacramento, a recent behavior and policy summit for policy makers convened in California, a U.S. Department of Energy workshop on the topic, and a series of behavior-focused White Papers commissioned by the California Public Utilities Commission through the UC California Institute for Energy and Environment. The Principal Investigator for this contract has made significant contributions in all of these efforts.

The California Energy Commission routinely uses data on residential sector energy use, household technologies, building characteristics, and efficiency potentials to produce forecasts of growth in energy demand and to inform the development of energy policies and programs. Data are also collected by state and Federal agencies, and utility companies, on factors that influence energy use and conservation. However, conventional modeling approaches in the U.S. and internationally tend to focus narrowly on hardware technologies, treating the behavioral dimensions of technology choice and energy use as relatively unimportant. As a result, the considerable variability in energy use and efficiency investment across the population tends to be overlooked in energy policy analysis and forecasting.

However, there is also tradition of residential energy analysis focused on household consumption patterns and variability. Much of that work has concerned electricity

demand modeling, and a little has considered natural gas usage. Although sophisticated econometric techniques are sometimes used, those analyses have frequently relied upon very limited data and simplified models. Gas and electricity are seldom considered together, and occupant behaviors are rarely explicitly examined. Such limited analyses have been sufficient for forecasting continuously growing consumption and informing modest efficiency goals. However, policies that are now aimed at very large scale reductions in energy use and emissions require considerably better understandings of the structures of demand and more complete (and sophisticated) models bases on better quality data.

Goals of the Agreement

The goal of this project is to develop next-generation models, data sources, policy and technology analyses to provide an improved understanding of residential demand for natural gas, both directly consumed and through electricity demands. The results are intended to improve energy policies and energy efficiency programs, and to accelerate the reduction of California greenhouse gas emissions.

This research will significantly advance the state-of-the-art in residential energy modeling and policy support. It will involve revisiting conventional modeling techniques and assumptions. It will identify needs for better quality and more comprehensive data on the determinates of demand (i.e., weather, buildings, HVAC systems, appliances, occupant behavior, and technology choice). It will support collection of those data. It will construct and test a range of advanced models of residential consumption and conservation. Specific analyses of existing micro-data that have rarely been analyzed to date will examine household details of residential technology use and efficiency choice. Conservation potentials will be estimated using various sources of empirical data on actual consumer behavior patterns (e.g., as opposed to simple engineering estimates and averages). And greenhouse gas emissions for various energy end-uses, household types, lifestyles, and regions will be estimated in order to understand the relative importance of different emissions sources and reduction potentials. The project will also attempt to develop a new decision-support tool for policy support.

Objectives of the Agreement

The objectives of this Agreement are to:

- Determine the limits of current residential sector energy use and conservation models and data sources.
- Collect data needed to support advanced modeling and analysis.
- Construct and test next-generation models.
- Perform a series of detailed micro-analyses to inform current policy efforts.

TASK 1.0 ADMINISTRATION

MEETINGS

Task 1.1 Attend Kick-off Meeting

The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

The Contractor shall:

- Attend a "kick-off" meeting with the Commission Contract Manager, the Contracts Officer, and a representative of the Accounting Office. The Contractor shall bring their Project Manager, Contracts Administrator, Accounting Officer, and others designated by the Commission Contract Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Contract Manager will provide an agenda to all potential meeting participants.

The administrative portion of the meeting shall include, but not be limited to, the following:

- Terms and conditions of the Agreement
- CPRs (Task 1.2)
- Match fund documentation (Task 1.7)
- Permit documentation (Task 1.8)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Commission Contract Manager's expectations for accomplishing tasks described in the Scope of Work;
- An updated Schedule of Deliverables
- Progress Reports (Task 1.4)
- Technical Deliverables (Task 1.5)
- Final Report (Task 1.6)
- Establish the PAC (Task 1.10)
- PAC Meetings (Task 1.11)

The Commission Contract Manager shall designate the date and location of this meeting.

Contractor Deliverables:

- An Updated Schedule of Deliverables
- An Updated List of Match Funds
- An Updated List of Permits
- Schedule for Recruiting PAC Members

Commission Contract Manager Deliverables:

- Final Report Instructions

Task 1.2 CPR Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and if it should, are there any modifications that need to be made to the tasks, deliverables, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Contractor. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Contract Manager and as shown in the Technical Task List above and in the Schedule of Deliverables. However, the Commission Contract Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Contractor.

Participants include the Commission Contract Manager and the Contractor, and may include the Commission Contracts Officer, the PIER Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Contract Manager to provide support to the Energy Commission.

The Commission Contract Manager shall:

- Determine the location, date and time of each CPR meeting with the Contractor. These meetings generally take place at the Energy Commission, but they may take place at another location.

- Send the Contractor the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.

- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.

- Determine whether to continue the project, and if continuing, whether or not to modify the tasks, schedule, deliverables and budget for the remainder of the Agreement, including not proceeding with one or more tasks. If the Commission Contract Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration Policy Committee for its concurrence.

- Provide the Contractor with a written determination in accordance with the schedule. The written response may include a requirement for the Contractor to revise one or more deliverable(s) that were included in the CPR.

The Contractor shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other deliverables identified in this Scope of Work. Submit these documents to the Commission Contract Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.

- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Contractor Deliverables:

- CPR Report(s)
- CPR deliverables identified in the Scope of Work

Commission Contract Manager Deliverables:

- Agenda and a List of Expected Participants
- Schedule for Written Determination
- Written Determination

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement.

The Contractor shall:

- Meet with the Energy Commission to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

  This meeting will be attended by, at a minimum, the Contractor, the Commission Contracts Officer, and the Commission Contract Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Contract Manager.

  The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Agreement. The Commission Contract Manager will determine the appropriate meeting participants.

  The administrative portion of the meeting shall be a discussion with the Commission Contract Manager and the Contracts Officer about the following Agreement closeout items:

  - What to do with any state-owned equipment (Options)
  - Need to file UCC.1 form re: Energy Commission's interest in patented

technology
- Energy Commission's request for specific "generated" data (not already provided in Agreement deliverables)
- Need to document Contractor's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions, such as repayment provisions and confidential deliverables
- Final invoicing and release of retention

- Prepare a schedule for completing the closeout activities for this Agreement.

Deliverables:
- Written documentation of meeting agreements and all pertinent information
- Schedule for completing closeout activities

REPORTING

See Exhibit D, Reports/Deliverables/Records.

Task 1.4 Monthly Progress Reports
The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement.

The Contractor shall:

- Prepare progress reports which summarize all Agreement activities conducted by the Contractor for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Contract Manager within 10 working days after the end of the reporting period. Attachment A-2, Progress Report Format, provides the recommended specifications.

Deliverables:
- Monthly Progress Reports

Task 1.5 Test Plans, Technical Reports and Interim Deliverables
The goal of this task is to set forth the general requirements for submitting test plans, technical reports and other interim deliverables, unless described differently in the Technical Tasks. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

http://www.energy.ca.gov/contracts/pier/contractors/index.html

The Contractor shall:

- Unless otherwise directed in this Scope of Work, submit a draft of each deliverable listed in the Technical Tasks to the Commission Contract Manager for review and comment in accordance with the approved Schedule of Deliverables. The Commission Contract Manager will provide written comments back to the Contractor on the draft deliverable within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 5 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

Task 1.6 Final Report

The goal of this task is to prepare a comprehensive written Final Report that describes the original purpose, approach, results and conclusions of the work done under this Agreement. The Commission Contract Manager will review and approve the Final Report. The Final Report must be completed on or before the termination date of the Agreement. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

http://www.energy.ca.gov/contracts/pier/contractors/index.html

The Final Report shall be a public document. If the Contractor has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Contractor shall perform the following subtasks for both the public and confidential versions of the Final Report.

Task 1.6.1 Final Report Outline

The Contractor shall:

- Prepare a draft outline of the Final Report.

- Submit the draft outline of Final Report to the Commission Contract Manager for review and approval. The Commission Contract Manager will provide written comments back to the Contractor on the draft outline within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final outline to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final outline within 5 working days of receipt.

Deliverables:

- Draft Outline of the Final Report
- Final Outline of the Final Report

Task 1.6.2 Final Report

The Contractor shall:

- Prepare the draft Final Report for this Agreement in accordance with the approved outline.

- Submit the draft Final Report to the Commission Contract Manager for review and comment. The Commission Contract Manager will provide written comments within 10 working days of receipt.

  Once agreement on the draft Final Report has been reached, the Commission Contract Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Commission Contract Manager shall provide written approval to the Contractor within 5 working days.

- Submit one bound copy of the Final Report with the final invoice.

Deliverables:

- Draft Final Report
- Final Report

MATCH FUNDS, PERMITS, AND ELECTRONIC FILE FORMAT

Task 1.7 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. While the PIER budget for this task will be zero dollars, the Contractor may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds during the term of this Agreement. Match funds must be identified in writing, and the associated commitments obtained before the Contractor can incur any costs for which the Contractor will request reimbursement.

The Contractor shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:

  1. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state such in the letter.

2. If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:

   - A list of the match funds that identifies the:
     - Amount of each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied.

     - Amount of each in-kind contribution, a description, documented market or book value, and its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Contractor shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.

   - A copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.

- Discuss match funds and the implications to the Agreement if they are significantly reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.

- Provide the appropriate information to the Commission Contract Manager if during the course of the Agreement additional match funds are received.

- Notify the Commission Contract Manager within 10 working days if during the course of the Agreement existing match funds are reduced. Reduction in match funds may trigger an additional CPR.

Deliverables:
- A letter regarding Match Funds or stating that no Match Funds are provided
- Letter(s) for New Match Funds
- A copy of each Match Fund commitment letter
- Letter that Match Funds were Reduced (if applicable)

Task 1.8 Identify and Obtain Required Permits

The goal of this task is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track.

Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement. While the PIER budget for this task will be zero dollars, the Contractor shall show match funds for this task. Permits must be identified in writing

and obtained before the Contractor can incur any costs related to the use of the permits for which the Contractor will request reimbursement.

The Contractor shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:

    1. If there are no permits required at the start of this Agreement, then state such in the letter.

    2. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:

        - A list of the permits that identifies the:
            - Type of permit
            - Name, address and telephone number of the permitting jurisdictions or lead agencies
        - Schedule the Contractor will follow in applying for and obtaining these permits.

- The list of permits and the schedule for obtaining them will be discussed at the kick-off meeting, and a timetable for submitting the updated list, schedule and the copies of the permits will be developed. The implications to the Agreement if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in the progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the appropriate information on each permit and an updated schedule to the Commission Contract Manager.

- As permits are obtained, send a copy of each approved permit to the Commission Contract Manager.

- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Contract Manager within 5 working days. Either of these events may trigger an additional CPR.

Deliverables:

- A letter documenting the Permits or stating that no Permits are required
- Updated list of Permits as they change during the Term of the Agreement
- Updated schedule for acquiring Permits as it changes during the Term of the Agreement
- A copy of each approved Permit

Task 1.9 Electronic File Format

The goal of this task is to unify the formats of electronic data and documents provided to the Energy Commission as contract deliverables. Another goal is to establish the computer platforms, operating systems and software that will be required to review and approve all software deliverables.

The Contractor shall:

- Deliver documents to the Commission Contract Manager in the following formats:
  - Data sets shall be in Microsoft (MS) Access or MS Excel file format.
  - PC-based text documents shall be in MS Word file format.
  - Documents intended for public distribution shall be in PDF file format, with the native file format provided as well.
  - Project management documents shall be in MS Project file format.

- Request exemptions to the electronic file format in writing at least 90 days before the deliverable is submitted.

Deliverables:

- A letter requesting exemption from the Electronic File Format (if applicable)

Task 1.10 Establish the PAC

The goal of this task is to create an advisory committee for this Agreement.

The PAC should be composed of diverse professionals. The number can vary depending on potential interest and time availability. The Contractor's Project Manager and the Commission Contract Manager shall act as co-chairs of the PAC. The exact composition of the PAC may change as the need warrants. PAC members serve at the discretion of the Commission Contract Manager.

The PAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter
- Members of the trades who will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives)
- Public Interest Market Transformation Implementers
- Product Developers relevant to project subject matter
- U.S. Department of Energy Research Manager
- Public Interest Environmental Groups
- Utility Representatives
- Members of the relevant technical society committees

The purpose of the PAC is to:

- Provide guidance in research direction. The guidance may include scope of research; research methodologies; timing; coordination with other research. The guidance may be based on:

  -technical area expertise
  -knowledge of market applications
  -linkages between the agreement work and other past, present or future research (both public and private sectors) they are aware of in a particular area.

- Review deliverables. Provide specific suggestions and recommendations for needed adjustments, refinements, or enhancement of the deliverables.
- Evaluate tangible benefits to California of this research and provide recommendations, as needed, to enhance tangible benefits.
- Provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

The Contractor shall:

- Prepare a draft list of potential PAC members that includes name, company, physical and electronic address, and phone number and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting. This list will be discussed at the kick-off meeting and a schedule for recruiting members and holding the first PAC meeting will be developed.
- Recruit PAC members and ensure that each individual understands the member obligations described above, as well as the meeting schedule outlined in Task 1.11.
- Prepare the final list of PAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each PAC member.

Deliverables:

- Draft List of PAC Members
- Final List of PAC Members
- Letters of acceptance, or other comparable documentation of commitment for each PAC Member

Task 1.11 Conduct PAC Meetings

The goal of this task is for the PAC to provide strategic guidance to this project by participating in regular meetings or teleconferences.

The Contractor shall:

- Discuss the PAC meeting schedule at the kick-off meeting. The number of face-to-face meetings and teleconferences and the location of PAC meetings shall be determined in consultation with the Commission Contract Manager. This draft

schedule shall be presented to the PAC members during recruiting and finalized at the first PAC meeting.

- Organize and lead PAC meetings in accordance with the schedule. Changes to the schedule must be pre-approved in writing by the Commission Contract Manager.
- Prepare PAC meeting agenda(s) with back-up materials for agenda items.
- Prepare PAC meeting summaries, including recommended resolution of major PAC issues.

Deliverables:

- Draft PAC Meeting Schedule
- Final PAC Meeting Schedule
- PAC Meeting Agenda(s) with Back-up Materials for Agenda Items
- Written PAC meeting summaries, including recommended resolution of major PAC issues

TECHNICAL TASKS

The Contractor shall prepare all deliverables in accordance with the requirements in Task 1.5. Deliverables not requiring a draft version are indicated by marking "(no draft)" after the deliverable name.

Task 2.0 Integrate Theory and Evaluate Data

The goal of this task is to synthesize existing knowledge related to residential energy use, conservation behavior, efficiency technology choice, and demand modeling. An integrated theoretical model will be constructed that formally states current understandings of the relationships among environmental, building, technology, and behavioral determinates of residential energy demand. Inventories of existing data on residential consumption of natural gas and electricity will also be constructed, including information on variables, data quality and information gaps.

The Contractor shall:

- Identify and create an inventory of literature reviews and key empirical studies.
- Construct a database of key physical, technical and behavioral variables that includes information on concept definition, levels of measurement, data sources, and estimated effects.
- Assess strengths, weaknesses, areas of agreement, and areas of uncertainty across existing theories.
- Consult with knowledgeable investigators and policy analysts working in the area of household energy use for additional insights.
- Construct a formal integrated theoretical model that will guide analysis and data collection in subsequent tasks, and that will be tested and refined over the course of the project on the basis of advanced modeling.
- Submit a written Integrated Theory Report describing the model.
- Identify existing sources of residential energy use and behavior data, particularly those that include information on California residences.
- Inventory data sets and develop descriptions of samples, variables, strengths and

limitations. Submit the resulting Data Inventory Report.

- Communicate results through research/policy briefings, reports, scientific journal articles, and conference proceedings.

Deliverables:

- Integrated Theory Report
- Data Inventory Report

Task 3.0 Assess Conventional Models

The goal of this task is to assess the state-of-the-art in residential sector energy modeling of natural gas and electricity, as well as in the household-level modeling of energy conservation actions and potentials. Conventional models will be tested, compared to one another, and compared to the integrated theory model.

The Contractor shall:

- Conduct a review of relevant policy reports and model documentation produced over the past twenty years in California related to residential sector energy use (e.g., forecast models, technology assessments, energy efficiency data bases), with focus on natural gas demand.
- Identify significant models and compare their architectures, assumptions, data requirements, levels of precision, inputs and outputs.
- Compare models to the integrated theory model and consider the implications of significant differences between models.
- Conduct preliminary assessments of model performance by testing alternative model specifications using different sources of data on residential demand.
- Identify relative strengths and weaknesses of the models considered in this task.
- Communicate results through research/policy briefings, reports, scientific journal articles, and conference proceedings.
- Prepare and submit a Model Comparative Performance Report summarizing the work performed in this task.

Deliverables:

- Model Comparative Performance Report

Task 4.0 Data Collection, Advanced Analysis Planning

The goal of this task is to identify missing variables and other gaps in data sources, factor and measurement that limit the comprehensiveness and precision of residential demand models. Having identified those limitations, data collection activities will allow incorporation of missing elements to models and support advanced model development.

The Contractor shall:

- Identify data supplementation needs based on integrated theory assessment, data inventory and examination/testing of conventional models in Tasks 2.0 and 3.0

above.

- Develop Data Collection Plans, including sampling and data collection methods to be used, the nature and quality of resulting samples, variables and coding, and analyses to be supported using those data.
- Conduct data collection through several surveys (telephone, mail and online), depth interviews, on-site monitoring, and acquisition of utility data (monthly billing and interval meter data), weather data, building characteristics/appliance stock data (from home energy audit program data), and possibly some combination of Census data, geographic information and proprietary data.
- Document data collection process and results. Prepare three to five Short Reports on specific data collection activities.
- Assemble data sets. Examine and clean data, and collect documentation. Submit a Data Descriptor Report containing descriptions and documentation of the data sets.
- Explore the state-of-the-art in advanced statistical modeling in energy-related and non-energy areas of scientific analysis and applications.
- Develop plans for advanced analysis that will apply and test these techniques in the residential energy context.
- Communicate results through research/policy briefings, reports, scientific journal articles, and conference proceedings.
- Prepare a Model Report which reviews advanced models and applications and presents an advanced analysis plan.
- Prepare the 1st CPR Report.
- Participate in the CPR.

Deliverables:

- Data Collection Plans
- Short Reports (three to five)
- Data Descriptor Report
- Model Report
- 1st CPR Report

Task 5.0 Advanced Modeling

The goal of this task is to apply and evaluate advanced modeling techniques from other energy-related and non-energy contexts to improved quality data on residential energy use, technology choice and conservation behavior. This will require testing model specifications and performance, and evaluating relative usefulness in policy support and program development.

The Contractor shall:

- Obtain needed specialized modeling software and/or modules/code for common analytic software.
- Fit and test alternative models.
- Compare model performance (including robustness of results, of stability of estimators, sensitivity to data variability across cases and consumer sub-types,

ability to handle simultaneous effects of environmental, physical and socio-behavioral variables).

- Consult with energy policy analysts and modelers to assess the applicability and usefulness of models and outputs for policy development purposes.
- Submit a Comparison Report detailing the comparative usefulness of alternative models for policy applications.
- Communicate results through research/policy briefings, reports, scientific journal articles, and conference proceedings.
- Submit a Testing Report on model testing and performance. This report may be combined with the Comparison Report.
- Prepare the 2nd CPR Report.
- Participate in the CPR.

Deliverables:

- Testing Report
- Comparison Report
- 2nd CPR Report.

Task 6.0 Specific In-depth Analyses

The goal of this task is to design and conduct a series of analyses of the best available data, using the most appropriate models and techniques, to examine specific behavior-related topics in residential energy demand that are of particular policy interest.

The Contractor shall:

- Consult with PAC members and other energy policy and program development experts in government, utilities, academia, business, and the non-profit sector to identify areas in which targeted analyses of residential energy and behavior data that have rarely been examined in detail may be of particular value.
- Develop a Targeted Research Plan that includes details of policy questions, assessment of available data, general research designs and modeling approaches, and a recruitment plan for academic analysts to work on topics outside of the specific expertise, interest and availability of core research team members. Topics to be considered shall include, but will not be limited to:
  - differences in time-varying patterns of energy demand;
  - Energy Commission demand forecasting questions related to: end-use "unit energy consumption" (UEC) estimates and "miscellaneous end uses," where uncertainties and error now require significant model calibration adjustments;
  - <u>weaknesses in statistical techniques such as "conditional demand analysis" (CDA) commonly used to estimate end-use loads from household sample data;</u>
  - environmental justice/equity issues related to basic energy needs, housing and appliance stocks, efficiency choices, and program participation of low-income and other hard-to-reach consumer segments;
  - heating and cooling control behavior;
  - consumer response to time-of-use rates and DR enabling technology ;

- types and logics of conservation action;
- details of choice among technologies and efficiencies, including solar applications;
- major home retrofit choice;
- social patterning of appliance saturations and building characteristics;
- testing and comparing the performance of segmentation typologies across different utility territories;
- assessing long-term policy impacts of codes, programs, etc.;
- the magnitudes and dynamics of take-back/rebound effects;
- appliance signature analysis (behavioral operations profiling from interval household-level load data);
- carbon emissions reduction studies;
- scenario assessments of locus of end-use and energy source trade-offs; ~~and~~
- decision-support simulation~~.~~;
- potentials for improving building design simulation modeling (e.g., Title 24) by incorporating more fine-grained information about occupant behavior;
- determining the effects of inaccuracies in home energy audit and energy performance "scoring" or "labeling" modeling that use "standard occupancy" assumptions rather than measured resident characteristics and usage; and
- comparing the accuracy of end-use estimation results from CDA, advanced metering infrastructure (AMI) and emerging technologies aimed at low-cost end-use measurement.

- Assemble needed data sets.
- Conduct and manage specific in-depth analyses.
- Communicate results through research/policy briefings, reports, scientific journal articles, and conference proceedings.
- Prepare a minimum of ~~ten~~ eighteen specific In-Depth Analysis Reports based on topics covered in the Targeted Research Plan.

- **Deliverables:**
- Targeted Research Plan.
- 3rd CPR Report.
- In-Depth Analysis Reports (minimum ~~10~~ 18).